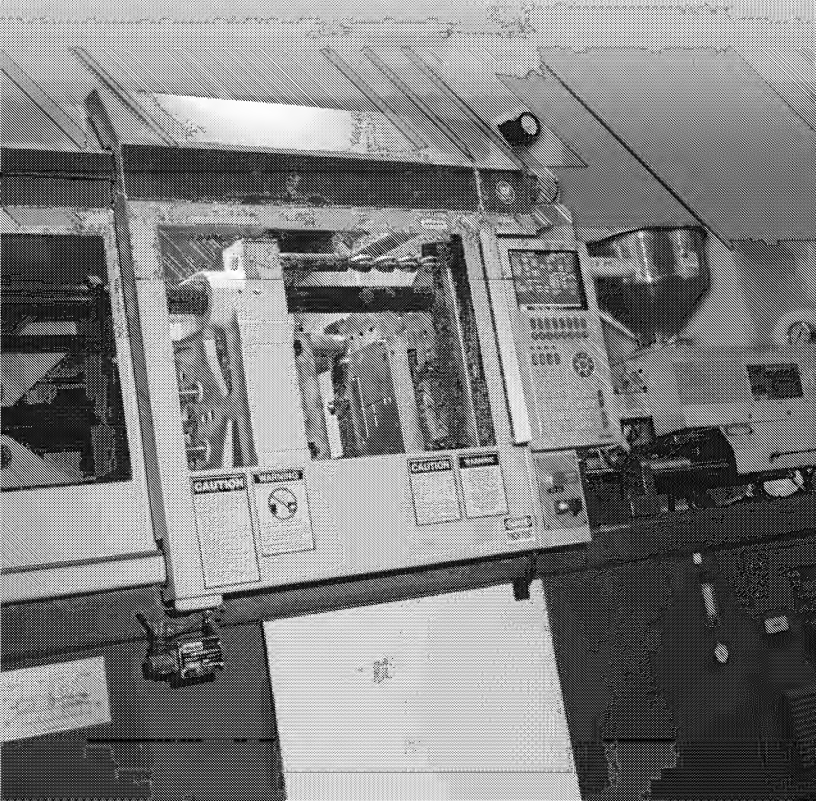


ExxonMobil
Chemical

Polypropylene

Injection Molding Problems & Solutions



POLYPROPYLENE INJECTION MOLDING PROBLEMS & SOLUTIONS

Problem	Causes	Possible Solutions
1. Sink Marks	Part is underfilled or has excessive shrinkage in thicker sections	<ul style="list-style-type: none"> • Increase shot size • Maintain adequate cushion • Increase cavity or hold pressure • Melt or mold temperature too high (if gate freeze-off too slow) • Increase hold time • Reduce fill rate • Cool sink area faster • Open gates • Reduce wall thickness of intersecting rib or boss • Improper gate locations or design
2. Voids	Part is underfilled or has excessive shrinkage	<ul style="list-style-type: none"> • Incomplete mold fill (short shot) • Maintain adequate cushion • Poor venting • Improper gate location • Injection rate too high • Excessive part thickness (+ 0.25 in. or 0.64 cm.)
3. Shrinkage	Volume decreases as plastic cools and crystallizes or part is not fully packed out due to gates freezing off too soon or insufficient cooling time	<ul style="list-style-type: none"> • Excessive shrinkage – Increase cavity pressure and hold time • Part oversized or not enough shrinkage – Decrease cavity pressure • Maintain adequate cushion • Increase hold time • Delay gate sealing to allow pack out (increase melt temperature) • Mold or melt temperature too high (gates not freezing off) • Improperly balanced cavity and core temperatures • Runners or gates too small • Wall thickness variation
4. Poor Weld Line Strength	The convergence of flow fronts past an obstacle or merging flow fronts in multi-gated molds results in a weak, interfacial bond	<ul style="list-style-type: none"> • Increase peak cavity pressure (fill faster) • Increase mold and melt temperatures • Increase hold pressure and time • Change gate location
5. Flash	Insufficient clamp force, mold surface is deflecting, mold shutoff surfaces not seating properly	<ul style="list-style-type: none"> • Decrease peak cavity pressure (decrease fill rate and/or use profile injection) • Decrease melt temperature • Increase clamp force • Clean mold surfaces • Check mold surface for flatness • Check integrity of mold shutoff • Change gate location • Use larger press

Problem	Causes	Possible Solutions
6. Burning	Compressed air in the mold degrades resin	<ul style="list-style-type: none"> • Decrease peak cavity pressure (decrease fill rate and/or use profile injection) • Clean vents, increase size or number of vents • Reduce melt temperature
7. Warp	Non-uniform stress due to excessive orientation and/or shrinkage	<ul style="list-style-type: none"> • Part ejected too hot (increase cycle time) • Mold at high temperatures, low pressures, and moderate fill rates • Decrease injection fill rate • Improperly balanced core and cavity temperature • Molded in stress due to low stock temperature and cold mold • Minimize hot spots in mold • Improperly balanced multiple gates • Flow too long, insufficient gates • Change gate location
8. Brittle Parts	Excessive orientation, degradation of resin, over packing, contamination, or improper design	<ul style="list-style-type: none"> • Increase injection fill rate • Increase melt temperature • Increase mold temperature and cool time • Over packing (decrease hold pressure and time) • Degraded material (excessive melt temperature or long residence time in barrel) • Contamination from other polymers • Use of incompatible carrier resins in color concentrates or other additives • Unintentional nucleation from pigments • Improper design; inadequate radii at corners, notches, or threads
9. Poor Appearance (Flow marks, low gloss, rough surface, jetting, orange peel, etc.)	Flow front slips-sticks on mold surface, jets, or pulsates	<ul style="list-style-type: none"> • Increase cavity pressure • Fill speed and/or packing time too low • Increase melt and/or mold temperature • Cool more slowly • Mold temperature non-uniform or too low • Insufficient lubrication (internal lubricant or on tool surface) • Excessive mold lubricant (e.g. grease bleeding out of the mold) • Dirty mold surface (clean and/or polish) • Poor pigment dispersion • Increase venting • Improper gate location or design

General Processing Guidelines

Drying:

Generally unnecessary; however, may be required for aesthetic purposes or with highly filled products

Melt Temperature:
400-450°F
204-238°C

Barrel Temperature:

Rear – 390-440°F,
199-227°C
Middle – 390-450°F,
199-232°C
Front – 390-450°F,
199-238°C

Mold Temperature:

60-120°F, 15-49°C

Cushion:

0.25 in., 0.64 cm.

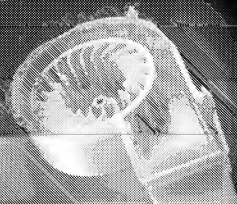
Pressures:

Boost – 500-1500 psi,
3.45-10.34 MPa
Hold – 50-75% of Boost
Back – 50-100 psi,
3.4-6.9 MPa
Screw RPM – medium
to fast

Times (sec):

Boost – 2-10
Hold – Adjust for gate
freeze-off
Cooling – Depends on
part thickness

Problem	Causes	Possible Solutions
10. Sticking in Mold	Over packing, excessive shrinkage, tool design causes physical attachment to the core or cavity	<ul style="list-style-type: none"> • Over packing, injection pressure too high – reduce • Under packing, excessive shrinkage – see solutions to Short Shot • Improperly balanced mold temperatures (colder on movable half) • Reduce cycle time (sticking on cores) • Increase cycle time (sticking in cavities) • Insufficient knockouts • Remove undercuts • Increase draft angles • Surface irregularities in the mold (polish cavity surfaces) • Highly polished core surface (vacuum lock), polish to a coarser finish, apply a surface coating, or increase venting
11. Gate Blush, Delamination or Cracking at the Gate	Melt fracture	<ul style="list-style-type: none"> • Adjust injection speed (increase or decrease) • Modify gate geometry (e.g. gate too small, land too long) • Add cold slug wells in runners • Increase melt and/or mold temperature
12. Black Specks or Discoloration	Degradation	<ul style="list-style-type: none"> • Excessive melt temperature or residence time in barrel • Improper venting • Possible contamination • Excessive screw RPM • Excessive back-pressure • Excessive shear created by the use of a mixing screw
13. Short Shot	Underfilled part	<ul style="list-style-type: none"> • Increase shot size • Inadequate cushion • Increase fill speed, pack pressure, and/or injection time • Increase melt and/or mold temperature • Plugged gates, runners, or vents • Inadequate melt flow rate (use higher MFR material) • Undersized gates, runners, and vents
14. Splay	Streaks on surface caused by volatiles such as moisture or degraded material	<ul style="list-style-type: none"> • Volatiles created by hot spot in manifold • Excessive moisture (dry resin) • Reduce melt temperature
15. Gate Stringing	Plastic strings on parts located at the gates formed during ejection	<ul style="list-style-type: none"> • Increase gate size (reduce orientation) • Decrease melt temperature, increase cooling time • Decrease drop tip temperature • Increase mold opening speed (break strings upon ejection) • Use valve gates



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